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Docket No.: 210314US2

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COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

RE: Application Serial No.: 09/895,319
Applicants: Toshiaki SHINOHARA
Filing Date: July 2, 2001
For: SEMICONDUCTOR DEVICE AND METHOD OF MANUFACTURING SAME
Group Art Unit: 2814
Examiner: NGUYEN, D. P.

SIR:

Attached hereto for filing are the following papers:

APPEAL BRIEF with APPENDICES

Our check in the amount of **$500.00** is attached covering any required fees. In the event any variance exists between the amount enclosed and the Patent Office charges for filing the above-noted documents, including any fees required under 37 C.F.R 1.136 for any necessary Extension of Time to make the filing of the attached documents timely, please charge or credit the difference to our Deposit Account No. 15-0030. Further, if these papers are not considered timely filed, then a petition is hereby made under 37 C.F.R. 1.136 for the necessary extension of time. A duplicate copy of this sheet is enclosed.

Respectfully submitted,

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DOCKET NO: 210314US2

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF	:	
TOSHIAKI SHINOHARA	:	EXAMINER: NGUYEN, D. P.
SERIAL NO: 09/895,319	:	
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APPEAL BRIEF

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

SIR:

This is an appeal of the Final Rejection dated October 19, 2004, of Claims 1-3, 5, and 7. A Notice of Appeal from this Final Rejection was timely filed on March 21, 2005.

I. REAL PARTY IN INTEREST

The real party in interest in this appeal is the Assignee MITSUBISHI DENKI KABUSHIKI KAISHA.

II. RELATED APPEALS AND INTERFERENCES

Appellant's legal representative and Assignee are aware of no appeals which will directly effect or be directly effected by or have any bearing on the Board's decision in this appeal.

III. STATUS OF THE CLAIMS

Claims 1-3, 6, and 7 have been finally rejected, Claims 4 and 8 have been allowed, and Claims 5 and 9-11 have been canceled. A clean copy of the pending Claims 1-4 and 6-8 is attached in the Claims Appendix.

IV. STATUS OF THE AMENDMENTS

No amendment has been filed after the Notice of Appeal. However, after the Final Office Action of October 19, 2004, an Amendment canceling Claim 5 and amending Claims 1, 4 and 8 to place them in better form for appeal was filed on January 19, 2005. That amendment has been entered for the purpose of the appeal as indicated in the Advisory Action mailed February 24, 2005.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

A heat produced by a power element placed on a metal block such that a lead frame is interposed between the power element and the metal block, is better dissipated if a bonding material between the lead frame and the metal block has a "good heat conduction."[1] As discussed in the specification at page 3, lines 13-21, the increase of a heat conduction of the bonding material decreases a dielectric breakdown voltage of the bonding material, which is undesirable. In other words, a bonding material having simultaneously a "good heat conduction" and a suitable dielectric breakdown voltage cannot be achieved by the conventional devices. The claimed semiconductor device solves the above problem of the conventional devices by providing (i) a bonding material that "achieves [a] good heat dissipation,"[2] and (ii) an insulation layer "responsible for a dielectric breakdown voltage."[3]

[1] Specification, page 7, lines 13-15.
[2] Id., lines 13-15.

The claimed structure of two elements, each having one of the two desired features, allows the bonding material to be selected with a high heat conduction "without the need for consideration of the dielectric breakdown voltage" feature[4] because the insulation layer is responsible for that feature. In addition, the bonding material is selected to have a "better heat conduction ... than the insulation layer."[5]

A semiconductor device having the properties discussed above is shown in Figure 1. The semiconductor device includes a power element 1, lead frames 2a and 2b, a metal block 5, a bonding material 10, and a resin package 6. The power element 1 is mounted on the lead frame 2a and the metal block 5 is bonded to a surface of the lead frame 2a, opposite from the power element 1, with a bonding material 10, as disclosed in the specification at page 10, lines 10-19. An insulation layer 7 is formed on an opposite surface of the metal block 5 from the lead frame 2a, and the resin package 6 seals the power element 1, the lead frame 2a, and the metal block 5, as disclosed in the original specification at page 11, lines 4-8. The bonding material has a higher heat conduction than the insulation layer, as disclosed in the specification at page 11, lines 19-20, and the insulation layer has a higher heat conduction than the resin package, as disclosed in the specification at page 5, line 25, to page 6, line 4, and also at page 15, lines 11-18.

The specification specifically discloses at page 6, lines 3-4, that "the insulation layer is better in heat conduction than the resin package." Further, the specification specifically discloses at page 11, lines 19-20, that "the bonding material 10 may employ a material of better heat conduction, e.g. solder, than the insulation layer 7."

By providing (i) the bonding material, (ii) the insulation layer that is different than the resin package, and (iii) the heat conduction of the bonding material higher than the heat

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[3] Id., page 7, lines 16-17.
[4] Id., page 7, lines 16-19.
[5] Id., page 11, lines 19-20.

conduction of the insulation layer, the semiconductor device of the present invention advantageously achieves (1) a high heat flow from the power element to the metal block because the bonding material has a high heat conduction, and (2) also maintains an electric breakdown voltage because of the insulation layer.[6]

Independent Claim 1 recites a semiconductor device that includes a semiconductor element, a lead frame having a first surface on which the semiconductor element is mounted, and a second surface opposite to the first surface, a metal block on the second surface of the lead frame, an insulation layer on the metal block opposite to the lead frame, and a bonding material between the second surface of the lead frame and the metal block. Further, Claim 1 recites that a resin package is configured to seal the semiconductor element, the lead frame, and the metal block while uncovering the insulation layer. The bonding material has a higher heat conduction than the insulation layer, and the insulation layer has a higher heat conduction than the resin package.

VI. GROUNDS OF REJECTIONS TO BE REVIEWED ON APPEAL

Appellant respectfully requests the Board to review on this appeal the rejection of Claims 1-3, 6, and 7 under 35 U.S.C. § 103(a) as unpatentable over Majumdar et al. (U.S. Patent No. 5,703,399, herein "Majumdar") in view of Wensel (U.S. Patent No. 5,959,349), and the rejection of Claim 3 under 35 U.S.C. § 103(a) as unpatentable over Majumdar in view of Wensel and Tanaka et al. (U.S. Patent No. 5,293,301, herein "Tanaka").

VII. ARGUMENT

A. The combination of Majumdar and Wensel does not render unpatentable Claims 1-3, 6, and 7.

[6] Id., page 7, lines 13-19.

Independent Claim 1 subject matter has been discussed above.

The Final Office Action states that Majumdar shows in Figure 13 a semiconductor device having a semiconductor element 4a, a lead frame 3, a metal block 1, and a bonding material 2 bonding a second surface of the lead frame 3 to the metal block 1. Also, the Final Office Action states at page 2, seventh line from the bottom, that "the bonding material 2 has a high heat conduction" and refers to column 8, line 18 of Majumdar for supporting that statement. Appellant notes that Majumdar discloses at column 8, line 18, a "highly heat conducting resin 2." However, Majumdar does not teach or suggest how high is the heat conduction of the highly heat conducting resin 2, or any relationship between the heat conduction of the resin 2 and any other component of the semiconductor device shown in Figure 13.

In addition, the Final Office Action recognizes at page 2, lines 5 and 4 from the bottom, that "Majumdar et al. fail to disclose an insulation layer on the metal block opposite the lead frame."

However, the Final Office Action fails to also state that because Majumdar does not disclose an insulation layer, and thus a heat conduction relationship between a bonding material and the insulation layer cannot be ascertained at this stage, and a teaching from another reference would be necessary to remedy this deficiency.

The Final Office Action relies on Wensel for disclosing an insulation layer, and states that Wensel shows in the cover figure a semiconductor element 214, a metal block 216 formed on a second surface of a lead frame 220, and an insulation layer 228 formed on the metal block 216, opposite to the lead frame 220.

Based on the above teachings of Majumdar and Wensel, the Final Office Action concludes that "it would have been obvious" to the artisan "to modify the device of

Majumdar et al. to prevent damage to the mold and heat sink, as shown by Wensel."[7] However, the Final Office Action does not address at all the claimed feature that the bonding material has a higher heat conduction than the insulation layer.

Therefore, at least for this reason, the rejection of Claim 1 under the combination of Majumdar and Wensel is improper because the Final Office Action did not address how that combination suggests to the artisan to use a bonding material having a higher heat conduction than an insulation layer. As will be discussed next, the combination suggests that the two layers have a similar heat conduction.

Assuming that the combination of Majumdar and Wensel is proper and the Final Office Action considers that the highly heat conducting resin 2 of Majumdar inherently has a higher heat conductivity than the dam 228 of Wensel, Appellant respectfully submits that the combination still fails to suggest to the artisan the features of Claim 1 as will be discussed next.

The semiconductor of Claim 1 requires two conditions to be satisfied: (i) the bonding material to have a higher heat conduction than the insulation layer, and (ii) the insulation layer to have a higher heat conduction than the resin package.

Majumdar discloses at column 8, lines 27-31, that the "highly heat conducting resin 2 is composed of a kind of composite material composed of epoxy resin with fillers mixed therein, as of alumina or aluminum nitride with precisely adjusted particle size, for example."

Therefore, Majumdar teaches that the highly heat conductive resin 2, which is asserted in the Final Office Action as corresponding to the claimed bonding material, is made of a combination of (i) an epoxy resin and (ii) fillers, as of alumina or aluminum nitride. If the fillers are not within the resin, the highly heat conductive resin 2 of Majumdar would not have a high heat conduction.

[7] Final Office Action, page 3, first paragraph.

Wensel shows in Figure 5 a resin package 224 and discloses at column 5, lines 32-36, that the dam 228 includes a material, "suitable for use in the transfer molding process, such as polyamides, Kapton™ tape, etc." The Final Office Action asserts that the dam 228 corresponds to the claimed insulation layer.

Further, Wensel discloses at column 5, lines 60-64, that the dam 228 "may include any suitable metal, such as copper, aluminum, copper alloys, aluminum alloys, etc., polyamides, and leadlock tape." Because the dam 228 must have a heat conduction higher than the resin package 224 to meet the feature (ii) of Claim 1, the dam 228 of Wensel must include the "suitable metal." Thus, the dam 228 of Wensel includes a resin (polyamide) and a metal, a structure similar to the highly heat conductive resin 2 of Majumdar.

Consequently, because of the similar structure of the dam 228 of Wensel and the highly heat conductive resin 2 of Majumdar, one cannot based on the teachings of the references themselves reach the conclusion that the highly heat conductive resin 2 has a higher heat conduction than the dam 228. Also, there is no evidence on the record that shows that the highly heat conductive resin 2 of Majumdar inherently has a heat conduction higher than the dam 228 of Wensel.

Therefore, Appellant respectfully submits that Claim 1 patentably distinguishes over the combination of Majumdar and Wensel.

B. Claim 3 patentably distinguishes over Majumdar, Wensel, and Tanaka, either alone or in combination.

The Final Office Action relies on Tanaka to teach that a metal block has a wider surface opposite to a bonding material than the bonding material. However, Tanaka does not overcome the deficiencies of Majumdar and Wensel discussed above. In addition, Claim 3 depends from independent Claim 1, which is believed to patentanbly distinguish over the

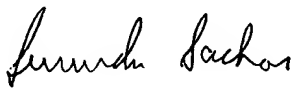
combination of Majumdar and Wensel. Accordingly, it is respectfully submitted this rejection be reversed for the same reasons as noted above.

VIII. CONCLUSION

It is respectfully submitted that the Final Rejections are improper, and therefore, all the outstanding rejections must be REVERSED.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.



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CLAIMS APPENDIX

Claim 1: A semiconductor device comprising:

a semiconductor element;

a lead frame having a first surface on which said semiconductor element is mounted, and a second surface opposite to said first surface;

a metal block on said second surface of said lead frame;

an insulation layer on said metal block opposite said lead frame;

a bonding material between said second surface of said lead frame and said metal block; and

a resin package configured to seal said semiconductor element, said lead frame and said metal block while uncovering said insulation layer,

wherein said bonding material has a higher heat conduction than said insulation layer, and

wherein said insulation layer has a higher heat conduction than said resin package.

Claim 2: The semiconductor device according to claim 1,

wherein said metal block is disposed in opposed relation to said semiconductor element.

Claim 3: The semiconductor device according to claim 1,

wherein said metal block has a wider surface opposite said bonding material than said bonding material.

Claim 4: A semiconductor device comprising:

a semiconductor element;

a lead frame having a first surface on which said semiconductor element is mounted, and a second surface opposite to said first surface;

a metal block on said second surface of said lead frame;

an insulation layer on said metal block opposite said lead frame; and

a bonding material between said second surface of said lead frame and said metal block,

wherein said bonding material has a higher heat conduction than said insulation layer,

wherein said semiconductor element includes a plurality of semiconductor elements, and

wherein said metal block is separate for each insulated unit between said semiconductor elements, and is provided in corresponding relation to at least one of said semiconductor elements.

Claim 6: The semiconductor device according to claim 1,

wherein said insulation layer comprises a base material with a same base as said resin package, and ceramic powder.

Claim 7: The semiconductor device according to claim 1,

wherein said metal block has a first surface and a second surface opposite said insulation layer,

wherein said first surface of said metal block is closer, as viewed in a vertical direction, to said lead frame than is said second surface of said metal block, and

wherein said bonding material lies between said second surface of said lead frame and said first surface of said metal block.

Claim 8: A semiconductor device comprising:

a semiconductor element;

a lead frame having a first surface on which said semiconductor element is mounted, and a second surface opposite to said first surface;

a metal block on said second surface of said lead frame;

an insulation layer on said metal block opposite said lead frame; and

a bonding material between said second surface of said lead frame and said metal block,

wherein said bonding material has a higher heat conduction than said insulation layer,

wherein said lead frame has a third surface on the same side as said second surface,

wherein said third surface is closer, as viewed in a vertical direction, to said semiconductor element than is said second surface, and

wherein an insulation space is defined between said metal block and said third surface.

X. EVIDENCE APPENDIX

NONE.

XI. RELATED PROCEEDINGS APPENDIX

NONE.